Amendments to the Specification

Please replace the paragraph beginning at page 1, line 21 with the following amended paragraph:

Ideally, the conversion of wind energy to usable electrical energy would be pollution free and have a zero negative impact on the earth's environment. In practice however, the use of popular wind turbines having rotor blades as long as 80 meters or longer and having tip speeds exceeding 100 mph introduce serious environmental hazards including visual and noise pollution and, perhaps of most immediate public concern, bird strikes. Bird mortality is a fact that proponents of modern wind turbines do not like to advertise and it is difficult to obtain bird mortality statistics. Dealers of wind equipment do however caution the use of such equipment within known or potential bird migratory routes, or within locations where threatened or endangered bird species live and nest. Rotor blade driven wind turbines pose a particular hazard to raptors, or birds of prey, many species of which are classified as endangered. The hazard is amplified by the fact that wind farm sites are generally chosen or maintained clear of trees and bushes, and are often populated by small rodents or rabbits, prey of raptors or hunting birds. The observed behavior of these birds is to focus so intently on the object of prey that they do not become aware of the hazard and are often struck and killed by the high speed rotor blades. It is not practical or cost effective to attempt to fence out or otherwise exclude prey of these birds from wind farm sites. It is clear that a more wildlife and habitat friendly wind energy conversion device is demanded. HSB Insurance Company, a major specialty insurer, published a February, 2004 article in "The Locomotive" entitled "The Changing Face of Wind Power". This article provides a brief summary of safety issues relating to environmental protection and in particular to aviary safety. U.S. Pat. No. 6,623,243 entitled "Minimization of Motion Smear, an Approach to Reducing Avian Collisions with Wind Turbines" to Hodos, (2003) emphasizes the need to address the serious problem of bird strikes by modern high speed wind turbine rotor blades. Hodos' work introduces the use of highly contrasting patterns in an attempt to reduce the 'motion smear', or motion blur that causes the rotor blades to appear nearly invisible to birds in

flight which approach wind turbines or wind farms having wind turbines of this type. Of the large number of wind turbine designs that have been produced especially over the last 40 years, the shrouded turbine is the only design that has the potential both to save birds harmless and provide the wind energy conversion efficiency and cost efficiency demanded of the application. Shrouded turbines generally allow the use of smaller and more enclosed rotor blades or impellors, and have physical shrouds or ring shaped concentrator wings that are highly visible to birds in flight but at the same time do not present moving objects, such as large rotating blades that are considered by many to visually mar the ~~naturally~~ natural landscape. Of the shrouded wind turbines, versions having two or more concentrator wings that allow the wind to flow between the concentrator wings and develop a vacuum or suction that drives the turbine, have demonstrated, in recent times, to be the most promising and efficient devices. A main object of the present invention is to make improvements to wind energy conversion devices of this type, such that these devices have greater conversion efficiency, and are made more practical and cost efficient.

Please replace the paragraph beginning at page 5, line 20 with the following amended paragraph:

In recent years, significant research and experimentation has been undertaken at the University of Udine, Italy. An article prepared by a group of the University of Udine published in the journal of Renewable Energy (February, 2003) by Dr. H. Grassmann et al., is entitled "A Partially Static Turbine – first experimental results". This article describes a prototype wind turbine having two shrouds or concentrator wings that allow a flow of air between the shrouds to develop an area of lower static pressure downwind of the turbine. An identical but unshrouded wind turbine is used for comparison. The article states that an increase of 100% of the power of the turbine was achieved in low wind velocities and 55% in high wind velocities. The lower percentage increase in power performance at high wind velocities (presumably 8 meters per second, or about 18 mph) is attributed, in the article, to turbulence generated by non-optimal impellor or rotor design. In the "Measurements" section the article states, "The simulation shows that consequently a large vortex behind the turbine is created. When one adds the shroud,

this vortex strongly increases. As a result the shroud augments the power of the turbine by only 20% with these blades." The article concludes at the end of this paragraph, "We strongly conclude at this point, that the quality of the propeller blades is very important for the performance of a shrouded turbine." In the "Conclusion" section at the end of the article this is reinforced, "The quality of the propeller is decisive for the performance of such a system. A dedicated program of optimization is needed for the propeller." The experimental results described in this article, for higher wind speed winds (although 18 mph is generally not considered high speed for wind turbines) show that as the vortex, or turbulence downstream of the wind turbine, increases with increasing wind speeds, the performance of the shrouded turbine markedly decreases. While it is given that the impellor blades produce a downstream turbulence it is not agreed that this turbulence is the cause of the "large vortex behind the turbine". The research of the applicant has demonstrated that the generation of the turbulent vortex is more fundamental and would occur even if the impellor blades were not present at all. The powerful stream of air that is drawn by suction through the smallest diameter shrouds forces directly downstream and interferes with the flow of wind over and between the concentrator wings that ~~is~~ are attempting to flow the wind outwards, away from the central axis. These are contrary forces, and in higher wind conditions, as the article indicates, the stronger force wins with the resultant formation of a large turbulent vortex, the aerodynamic stalling of the concentrator wings, and the loss of power. The phenomenon is analogous to a blow torch that blows itself out when too much gas pressure is applied. It is therefore a significant object of the present invention to introduce a flow regulator element installed in the downstream flow of air that is drawn through the turbine or smallest diameter shrouds so as to stabilize either the force of air flowing out of the turbine or smallest diameter shrouds or flowing through the impellor blades of the device. In so doing, it is unnecessary to optimize the impellor blades, certainly a futile attempt at least for higher speed winds. An additional use of the flow regulator element is as part of an aerobraking system that serves to respond quickly to wind gusts and control or restrict the flow of wind through the impellor and thereby protect the turbine from overspeeding in gusting or overly high wind conditions.

Please replace the paragraph beginning at page 7, line 2 with the following amended paragraph:

The foregoing describes a system and method for safely and efficiently extracting energy from wind and converting it to usable energy comprising one or more concentrator wings that react with the flow of wind to induce a drop in static air pressure that is then used to drive an impellor and power converter; and a flow regulator means having aerodynamic surfaces that direct the flow of wind entering a turbine shroud and impinging upon said flow regulator means outwards from a central axis running approximately parallel with the direction of said wind entering said turbine shroud and concentric with said concentrator wings, and additionally one or more of the following:

an aerobrake means such that the proximity of said turbine shroud to said flow regulator means is adjusted such that during overly high velocity wind conditions said proximity will be reduced so as to impede or restrict the flow of wind through said turbine shroud; ~~a said power converter~~ wherein said power converter is installed on the downwind side of said aerodynamic surfaces of said flow regulator means; and further comprising an impellor driveshaft connecting said impellor to said power converter, said impellor driveshaft extending out of said flow regulator means and positioning said impellor within the flow of wind passing through said turbine shroud; a downwind guidance means for supporting elements of ~~said~~ <u>the</u> invention, said downwind guidance means presenting little obstruction to the higher speed wind flow upstream of said elements of said invention, said downwind guidance means facilitating the orientation of said elements of said invention approximately into the oncoming wind and said downwind guidance means comprising a lee support means that supports said elements of said invention and extends in a downwind direction then turns outward from said central axis and connects with a swivel means that allows said elements of said invention to rotate around a common axis and effect said orientation.

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Please replace the paragraph beginning at page 8, line 27 with the following amended paragraph:

~~Fig. 1~~ Fig. 1A provides, on the left side of the page, a perspective view of the invention, and Fig. 1B provides, on the right side of the page, a cross-sectional view of the same revealing additional internal components.

Please replace the paragraph beginning at page 9, line 12 with the following amended paragraph:

~~Fig. 7~~ Fig. 7A and Fig. 7B ~~is a duplication~~ are duplications of ~~Fig. 1~~ Fig. 1A and Fig. 1B respectively, but including riser and foundation components and indicating the swivel action of the downwind guidance system.

Please replace the paragraph beginning at page 9, line 16 with the following amended paragraph:

The description of invention 10 as presented in ~~Fig. 1~~ Fig. 1A and Fig. 1B must begin with a description of how shrouded wind turbines having one or more concentrator wings 12 operate. Fig. 6 therefore illustrates schematically, a cross section of the flow of wind through turbine shroud 14 and through three additional shrouds or concentrator wings 12. Turbine shroud 14 serves to enclose impellor 16 which in turn serves to react with the wind flowing through turbine shroud 14 and drive power converter 22, not shown in this illustration, such as an alternator or generator. Concentrator wings 12 operate fundamentally the same as aircraft wings and have similar profiles as may be readily seen from Fig. 6. These profiles generally have a top convex shaped surface to accelerate the flow of wind, and a lower flattened or concaved surface that tends to slightly decelerate the flow of wind past these surfaces. The profiles of concentrator wings 12 as illustrated are inclined, or have, in aeronautical terms, an angle of incidence that cause the wind flow to be deflected outwards from a central axis that runs parallel with the wind flow and concentric with ~~concentric~~ concentrator wings 12 and turbine shroud 14. The obvious difference between concentrator wings 12 and wings of an aircraft is that concentrator wings 12

are generally, but not necessarily, ring shaped.

Please replace the paragraph beginning at page 13, line 15 with the following amended paragraph:

Fig. 3 illustrates impellor 16 attaching to impellor driveshaft 26 that passes through and is free to rotate within driveshaft housing 38. Impellor driveshaft 26 then enters flow regulator 18 that may also be used to house power converter 22, typically an alternator or generator, used to convert mechanical torque into usable electrical energy. It is an object of the present invention to remove power converter 22 from the high speed flow passing by impellor 16. The Background of Invention section of this application cites examples of wind turbines where the alternator or generator must be faired in to minimize aerodynamic drag losses incurred by the necessary placement of these elements within the high speed wind flow. Impellor driveshaft ~~22~~ <u>26</u> of the present invention extends impellor 16 into the high speed flow of wind drawn through turbine shroud 14 and as well allows power converter 22 to be enclosed within flow regulator 18 and out of this high speed flow. Concentrator wings 12 and flow regulator 18 work in conjunction to direct the wind flow outwards away from the central axis as described and cause the formation of a 'dead' or slow moving airspace downstream of the aerodynamic surfaces of flow regulator 18. This dead airspace provides an ideal location for power converter 22 especially when housed within flow regulator 18 and protected from weather and other elements of the natural environment.

Please replace the paragraph beginning at page 14, line 1 with the following amended paragraph:

In theory, and in practice, the highest energy extraction efficiency occurs when the wind is decelerated immediately downstream of a wind turbine to about 1/3 of its original free flowing velocity. This principle as well applies to shrouded wind turbines. This principle is applied in invention 10 and it is an object of the invention to mount and support elements of invention 10 to

present little obstruction to the higher speed wind flow upstream of components of invention 10, and, at once allow invention 10 to orient into the oncoming wind and preferably without the assistance of motor drives or ancillary wind direction sensing instruments. With reference again to Fig. 2, downwind guidance 30 serves as such. Downwind guidance 30 includes lee support 32, a mounting element that supports concentrator wings 12, flow regulator 18, and other elements of invention 10, and extends in a downwind direction into the slower moving wind flow on the leeward side of concentrator wings 12. Lee support 32 then turns outward from the previously described central axis of wind flow and finally connects with swivel 34 that is mounted just forward of the center of wind pressure upon concentrator wings 12 and other elements of invention 10 to allow these elements to rotate about swivel 34 and be directed or preferably self-orient appropriately into the oncoming wind. Swivel 34 best includes sealed roller bearings that permit low friction rotation of swivel 34 and ensure a long operational life in an outdoor environment. Swivel 34 may also include a ~~commuter~~ commutator plate (not illustrated) to conduct electrical power generated by power converter 22 through swivel 34 for further processing or utilization.

Please replace the paragraph beginning at page 14, line 21 with the following amended paragraph:

Referring now to ~~Fig. 7~~ Fig. 7A and Fig. 7B, care must also be taken to ensure that riser 42, which provides support to swivel 34 and as well extends elements of invention 10 into a freer unobstructed flow of wind, is mounted typically parallel to the local gravitational lines. Care must also be taken during design of embodiments of invention 10 to ensure that elements of invention 10 that are supported by swivel 34 are reasonably well balanced in a forward and aft direction to minimize any self-guidance error into the oncoming wind should riser 42 not be mounted exactly parallel to the local gravitational lines. Foundation 44 supporting riser 42 and other elements of invention 10 should as well be designed to accommodate the highest forces of wind anticipated for the region of installation. ~~Fig. 7~~ Fig. 7A and Fig. 7B as well ~~indicates~~

indicate, by the use of arrows, the action of downwind guidance 30 around a common axis defined by swivel 34.

Please replace the paragraph beginning at page 15, line 20 with the following amended paragraph:

In general, wind turbines having large rotor blade diameters of 80 meters or longer are unable to extract additional energy from winds exceeding 25 or 30 mph. In other words, the same amount of energy will be extracted from a wind of 25 mph as will be from a wind of 35 mph. This is a significant loss of potential energy given that power available in a wind increases to the cubic power of the wind velocity. These machines as well must be entirely shut down, rotor blades brought to a complete stop, at wind speeds about 45 or 50 mph. In winds generally greater than 25 mph, the long rotor blades of popular wind turbine designs develop tremendous forces that act on the blades themselves and upon the transmissions, bearings, braking systems and support structures of these machines. This is an important consequence when considering that the available power in a 35 mph wind approaches three times (2.74) the power available in a 25 mph <u>wind</u>, the top of the power generation curve for typical large rotor blade diameter wind turbines. Invention 10, because of flow regulator 18 is able to present a large frontal area to the oncoming wind while at once minimizing the size of rotor blades or impellor 16. By using smaller diameter rotor blades, embodiments of invention 10 are able to run impellor 16 at substantially higher rpm's and efficiently extract energy from significantly higher wind speeds as compared with popular wind turbines having large diameter rotor blades. As previously stated, shrouded wind turbines that do not include flow regulator 18 are not able to process these higher speed winds or even to provide a higher ratio of shroud diameter to impellor diameter without experiencing the stalling of the shrouds as described.